CLAIMS

What is claimed is:

1. A pixel for an IR sensor, comprising:

a substrate assembly having a cavity defined by at least one sidewall;

a cantilevered beam connected to the substrate assembly and disposed in the cavity, the cantilevered beam including a first spring portion and a first capacitor plate portion, wherein the first spring portion includes at least two materials having different coefficients of thermal expansion; and

a second capacitor plate portion, such that incident IR radiation causes the first spring portion of the cantilevered beam to move laterally relative to the sidewall, thereby creating a variable capacitance between the first capacitor plate portion of the cantilevered beam and the second capacitor plate portion.

2. The pixel of claim 1, wherein the cantilevered beam further includes a first thermal isolation portion between the substrate assembly and the first spring portion.

3. The pixel of claim 1, wherein the cantilevered beam includes a CMOS micromachined beam.

4. The pixel of claim 1, wherein the first spring portion includes a metal layer and a dielectric layer with different coefficients of thermal expansion.

5. The pixel of claim 4, wherein the metal layer includes aluminum and the dielectric layer includes silicon dioxide.

6. A pixel for an IR sensor, comprising:

a substrate assembly having a cavity defined by at least one sidewall;

a first cantilevered beam connected to the substrate assembly and disposed in the cavity, the first cantilevered beam including a first spring portion and a first capacitor plate portion, wherein the first spring portion includes at least two materials having different coefficients of thermal expansion; and

a second cantilevered beam connected to the substrate assembly and disposed in the cavity, the second cantilevered beam including a second spring portion and a second capacitor plate portion, wherein the second spring portion includes at least two materials having different coefficients of thermal expansion such that incident IR radiation causes the first and second spring portions to move laterally relative to the sidewall thereby creating a variable capacitance between the first and second capacitor plate portions.

7. The pixel of claim 6, wherein:

the first cantilevered beam further includes a first thermal isolation portion between the substrate assembly and the first spring portion; and

the second cantilevered beam further includes a second thermal isolation portion between the substrate assembly and the second spring portion.

8. The pixel of claim 6, wherein:

the first cantilevered beam includes a CMOS micromachined beam; and

the second cantilevered beam includes a CMOS micromachined beam.

9. The pixel of claim 6, wherein:

the first spring portion includes a metal layer and a dielectric layer with different coefficients of thermal expansion; and

the second spring portion includes a metal layer and a dielectric layer with different coefficients of thermal expansion.

10. The pixel of claim 9, wherein:

the metal layer of the first spring portion includes aluminum and the dielectric layer of the first spring portion includes silicon dioxide; and

the metal layer of the second spring portion includes aluminum and the dielectric layer of the second spring portion includes silicon dioxide.

11. The pixel of claim 6, wherein:

the first cantilevered beam has a shape selected from the group consisting of straight, meandering and curved; and

the second cantilevered beam has a shape selected from the group consisting of straight, meandering and curved.

12. The pixel of claim 6, further comprising a frame connected to the substrate assembly and positioned around the first and second cantilevered beams.

13. The pixel of claim 12, further comprising:

at least one post connected to the frame;

a plate connected to the post; and

an IR absorbing material located on the plate.

14. The pixel of claim 6, wherein:

the first capacitor plate portion includes a beam having a plurality of finger beams extending therefrom; and

the second capacitor plate portion includes a beam having a plurality of finger beams extending therefrom such that the finger beams of the first capacitor plate portion are interleaved with the finger beams of the second capacitor plate portion.

15. The pixel of claim 6 wherein a resonant mechanical frequency of the first cantilevered beam does not equal a resonant mechanical frequency of the second cantilevered beam.

16. The pixel of claim 6, further comprising:

at least one post connected to one of the first and second cantilevered beams;

a plate connected to the post; and

an IR absorbing material located on the plate.

17. A micromachined pixel for an IR sensor, comprising:

a substrate assembly having a cavity defined by at least one sidewall;

a first CMOS micromachined, cantilevered beam connected to the substrate assembly and disposed in the cavity, the first CMOS micromachined, cantilevered beam including a first spring portion and a first capacitor plate portion, wherein the first spring portion includes a metal layer and a dielectric layer having different coefficients of thermal expansion; and

a second CMOS micromachined cantilevered beam connected to the substrate assembly and disposed in the cavity, the second cantilevered beam including a second spring portion and a second capacitor plate portion, wherein the second spring portion includes a metal layer and a dielectric layer having different coefficients of thermal expansion, such that incident IR radiation causes the first and second spring portions to move laterally relative to the sidewall thereby creating a variable capacitance between the first and second capacitor plate portions.

18. The pixel of claim 17, wherein:

the first CMOS micromachined, cantilevered beam further includes a first thermal isolation portion between the substrate assembly and the first spring portion; and

the second CMOS micromachined cantilevered beam further includes a second thermal isolation portion between the substrate assembly and the second spring portion.

19. The pixel of claim 18, wherein:

the first thermal portion includes at least one slotted metal line; and

the second thermal portion includes at least one slotted metal line.

20. The pixel of claim 19, further comprising a frame connected to the substrate assembly and positioned around the first and second CMOS micromachined, cantilevered beams.

21. The pixel of claim 20, further comprising:

at least one post connected to the frame;

a plate connected to the post; and

an IR absorbing material located on the plate.

22. The pixel of claim 19, wherein:

the first capacitor plate portion includes a beam having a plurality of finger beams extending therefrom; and

the second capacitor plate portion includes a beam having a plurality of finger beams extending therefrom such that the finger beams of the first capacitor plate portion are interleaved with the finger beams of the second capacitor plate portion.

23. The pixel of claim 17, wherein a resonant mechanical frequency of the first CMOS micromachined, cantilevered beam does not equal a resonant mechanical frequency of the second CMOS micromachined, cantilevered beam.

24. The pixel of claim 19, further comprising:

at least one post connected to one of the first and second CMOS micromachined, cantilevered beams;

a plate connected to the post; and

an IR absorbing material located on the plate.

25. A micromachined structure, comprising:

a substrate assembly having a cavity defined by at least one sidewall;

a first cantilevered beam connected to the substrate assembly and disposed in the cavity, the first cantilevered beam including a first spring portion and a first capacitor plate portion, wherein the first spring portion includes at least two materials having different coefficients of thermal expansion; and

a second capacitor plate portion, such that incident IR radiation causes the first spring portion of the cantilevered beam to move laterally relative to the sidewall, thereby creating a variable capacitance between the first capacitor plate portion of the first cantilevered beam and the second capacitor plate portion.

26. The micromachined structure of claim 25, wherein the first cantilevered beam further includes a first thermal isolation portion between the substrate assembly and the first spring portion.

27. The micromachined structure of claim 25, wherein the first cantilevered beam includes a CMOS micromachined beam.

28. The micromachined structure of claim 25, wherein the second capacitor plate portion is part of a second cantilevered beam that is connected to the substrate assembly and

disposed in the cavity, the second cantilevered beam including a spring portion connected to the second capacitor plate portion, wherein the second spring portion includes at least two materials having different coefficients of thermal expansion, such that incident IR radiation causes the second spring portion to move laterally relative to the sidewall.

29. The micromachined structure of claim 28, wherein:

the first capacitor plate portion includes a beam having a plurality of finger beams extending therefrom; and

the second capacitor plate portion includes a beam having a plurality of finger beams extending therefrom such that the finger beams of the first capacitor plate portion are interleaved with the finger beams of the second capacitor plate portion.

30. The micromachined structure of claim 25, further comprising a frame connected to the substrate assembly and positioned around the first and second cantilevered beams.

31. An infrared (IR) imager, comprising:

an addressing circuit; and

a pixel array coupled to the addressing circuit, wherein the pixel array includes a plurality of IR sensitive pixels, each pixel including:

a first cantilevered beam connected to a substrate assembly and disposed in a cavity of the substrate assembly, wherein the cavity is defined by a sidewall, wherein the first cantilevered beam includes a first spring portion and a first capacitor plate portion, and wherein

the first spring portion includes at least two materials having different coefficients of thermal expansion; and

a second capacitor plate portion, such that incident IR radiation causes the first spring portion of the cantilevered beam to move laterally relative to the sidewall, thereby creating a variable capacitance between the first capacitor plate portion of the first cantilevered beam and the second capacitor plate portion.

32. The IR imager of claim 31, wherein the first cantilevered beam further includes a first thermal isolation portion between the substrate assembly and the first spring portion.

33. The IR imager of claim 31, wherein the first cantilevered beam includes a CMOS micromachined beam.

34. The IR imager of claim 31, wherein the second capacitor plate portion is part of a second cantilevered beam that is connected to the substrate assembly and disposed in the cavity, the second cantilevered beam including a spring portion connected to the second capacitor plate portion, wherein the second spring portion includes at least two materials having different coefficients of thermal expansion, such that incident IR radiation causes the second spring portion to move laterally relative to the sidewall.

35. The IR imager of claim 34, wherein:

the first capacitor plate portion includes a beam having a plurality of finger beams extending therefrom; and

the second capacitor plate portion includes a beam having a plurality of finger beams extending therefrom such that the finger beams of the first capacitor plate portion are interleaved with the finger beams of the second capacitor plate portion.

36. The IR imager of claim 31, further comprising a frame connected to the substrate assembly and positioned around the first and second cantilevered beams.

37. The IR imager of claim 31, further comprising an interface circuit coupled to each pixel.

38. The IR imager of claim 37, further comprising a capacitance detection circuit coupled to the addressing circuit.

39. An infrared (IR) imager, comprising:

an addressing circuit; and

a pixel array coupled to the addressing circuit, wherein the pixel array includes a plurality of IR sensitive pixels, each pixel including:

a first cantilevered beam connected to a substrate assembly and disposed in a cavity of the substrate assembly, wherein the cavity is defined by a sidewall, the first cantilevered beam including a first spring portion and a first capacitor plate portion, wherein the first spring portion includes at least two materials having different coefficients of thermal expansion; and

a second cantilevered beam connected to the substrate assembly and disposed in the cavity, the second cantilevered beam including a second spring portion and a second capacitor plate portion, wherein the second spring portion includes at least two materials having different coefficients of thermal expansion such that incident IR radiation causes the first and second spring portions to move laterally relative to the sidewall thereby creating a variable capacitance between the first and second capacitor plate portions.

40. The IR imager of claim 39, wherein:

the first cantilevered beam of each pixel further includes a first thermal isolation portion between the substrate assembly and the first spring portion; and

the second cantilevered beam of each pixel further includes a second thermal isolation portion between the substrate assembly and the second spring portion.

41. The IR imager of claim 39, wherein:

the first cantilevered beam of each pixel includes a CMOS micromachined beam; and

the second cantilevered beam of each pixel includes a CMOS micromachined beam.

42. The IR imager of claim 39, wherein:

the first spring portion of each pixel includes a metal layer and a dielectric layer with different coefficients of thermal expansion; and

the second spring portion of each pixel includes a metal layer and a dielectric layer with different coefficients of thermal expansion.

43. The IR imager of claim 39, wherein each pixel further includes a frame connected to the substrate assembly and positioned around the first and second cantilevered beams.

44. The IR imager of claim 43, wherein each pixel further includes:

at least one post connected to the frame;

a plate connected to the post; and

an IR absorbing material located on the plate.

45. The IR imager of claim 39, wherein each pixel further includes:

at least one post connected to one of the first and second cantilevered beams;

a plate connected to the post; and

an IR absorbing material located on the plate.

46. The IR imager of claim 39, wherein:

the first capacitor plate portion of each pixel includes a beam having a plurality of finger beams extending therefrom; and

the second capacitor plate portion of each pixel includes a beam having a plurality of finger beams extending therefrom such that the finger beams of the first capacitor plate portion are interleaved with the finger beams of the second capacitor plate portion.

47. The IR imager of claim 39, further comprising an interface circuit coupled to each pixel.

48. The IR imager of claim 47, further comprising a capacitance detection circuit coupled to the addressing circuit.

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